PSYCHE

A JOURNAL OF ENTOMOLOGY

ESTABLISHED IN 1874

Vol. 65 June-September, 1958 Nos. 2-3

CAMBRIDGE ENTOMOLOGICAL CLUB
1874

TABLE OF CONTENTS

A Chemical Releaser of Alarm and Digging Behavior in the Ant *Pogonomyrmex badius* (Latreille). *Edward O. Wilson* . . . 41

Mexican Snakeflies (Neuroptera: Raphidiodea). *F. M. Carpenter* 52

The Collembola of Lebanon and Western Syria. Part III: Family Isotomidae. *K. Christiansen* 59

The Indo-Australian Species of the Ant Genus Strumigenys: Fr. Smith: Group of *S. godeffroyi* in Borneo. *W. L. Brown, Jr.* . . . 81

CAMBRIDGE ENTOMOLOGICAL CLUB

Officers for 1958-59

President	N. Gilham, *Harvard University*
Vice-President	M. Parsons, *Radcliffe College*
Secretary	A. Stuart, *Harvard University*
Treasurer	F. M. Carpenter, *Harvard University*
Executive Committee	J. Woodland, *Salem State Teachers College* S. Duncan, *Boston University*

EDITORIAL BOARD OF PSYCHE

F. M. Carpenter (Editor), *Professor of Entomology, Harvard University*

P. J. Darlington, Jr., *Head Curator of Recent Insects, Museum of Comparative Zoology*

W. L. Brown, Jr., *Associate Curator of Insects, Museum of Comparative Zoology*

E. O. Wilson, *Associate Professor of Zoology, Harvard University*

H. Levi, *Associate Curator of Arachnology, Museum of Comparative Zoology*

PSYCHE is published quarterly, the issues appearing in March, June, September, and December. Subscription price, per year, payable in advance: $3.00 to subscribers in the United States and Canada; other subscriptions $3.35. Single copies, 85 cents.

Cheques and remittances should be addressed to Treasurer, Cambridge Entomological Club, Biological Laboratories, Harvard University, Cambridge, Mass.

Orders for back volumes, missing numbers, notices of change of address, etc., should be sent to the Editorial Office of Psyche, Biological Laboratories, Harvard University, Cambridge, Mass.

IMPORTANT NOTICE TO CONTRIBUTORS

Manuscripts intended for publication, books intended for review, and other editorial matter, should be addressed to Professor F. M. Carpenter, Biological Laboratories, Harvard University, Cambridge, Mass.

Authors contributing articles over 8 printed pages in length will be required to bear a part of the extra expense, for additional pages. This expense will be that of typesetting only, which is about $3.00 per page. The actual cost of preparing cuts for all illustrations must be borne by contributors; the expense for full page plates from line drawings is approximately $8.00 each, and for full page half-tones, $10.00 each; smaller sizes in proportion.

AUTHOR'S SEPARATES

Reprints of articles may be secured by authors, if they are ordered before, or at the time proofs are received for corrections. The cost of these will be furnished by the Editor on application.

The March, 1958, Psyche (Vol. 65, No. 1) was mailed May 22, 1959

EATON PRESS INC., WATERTOWN, MASS.

PSYCHE

Vol. 65 June-September, 1958 Nos. 2-3

A CHEMICAL RELEASER OF ALARM AND DIGGING BEHAVIOR IN THE ANT *POGONOMYRMEX BADIUS* (LATREILLE)

By Edward O. Wilson
Biological Laboratories, Harvard University

Introduction

The complex social behavior of ants appears to be mediated in large part by chemoreceptors. If it can be assumed that "instinctive" behavior of these insects is organized in a fashion similar to that demonstrated for the better known invertebrates, a useful hypothesis would seem to be that there exists a series of behavioral "releasers", in this case chemical substances voided by individual ants that evoke specific responses in other members of the same species. It is further useful for purposes of investigation to suppose that the releasers are produced at least in part as glandular secretions and tend to be accumulated and stored in glandular reservoirs. In support of this hypothesis one such releaser, the trail substance of fire ants, has been described elsewhere (Wilson, 1959). This agent effects short-range exploratory behavior and also serves as the chief orienting stimulus. Goetsch (1952) has suggested the existence of another class of chemical releasers in ants, the *Fernalarm* substances ,which are said to be released by excited workers to communicate a state of excitement within the colony. According to this author, workers of certain deserticolous species of the dolichoderine and formicine genera *Forelius, Tapinoma, Iridomyrmex, Dorymymex,* and *Camponotus* apparently can discharge abdominal secretions that create this effect among other workers through the air over short distances. Goetsch's interesting observation has not yet received experimental verification. The purpose of the present paper is to report on yet another chemical releaser, a secretion of the mandibular glands of the harvesting ant *Pogonomyrmex badius*. This agent is especially interesting, because it operates to release two seemingly unrelated complex behavior patterns, general alarm behavior and digging.

MATERIALS

Observations were made chiefly on colonies collected at Ocean Drive Beach, South Carolina, and Gulf Shores, Alabama, and maintained in artificial nests in the laboratory. Since the mother queens of *Pogonomyrmex* colonies are notoriously difficult to find in the field, a note on the collecting method employed would seem to be in order. The best results were obtained by excavating small nests during the early morning, preferably following rainfall. The upper portions of the nests were simply dug out with a spade and scattered over a ground-cloth until the queen was sighted. Under such conditions, roughly half the nests opened yielded queens during the first ten minutes of search. Other methods tried, including deep lateral excavations and the use of sieves, proved relatively inefficient.

The colonies were housed in the laboratory in vertical, multistoried, plexiglas nests. The horizontal galleries were fitted with sliding plexiglas walls that could be moved to allow cleaning and to give access to the interior of the nest. The floors of the galleries were made of softwood strips. Curved plastic tubes led from the outside to the ends of the wooden floors to allow periodic watering of the nest interior. A single opening led from the bottom gallery outside to a walled foraging arena. The ants had been gradually habituated to strong light, so that it was possible at all times to keep the nest interior brightly illuminated. The foraging arena was illuminated during twelve hours of each day by fluorescent lamps turned on and off by an automatic timing device. A more detailed description of this type of artificial nest, which has proven successful in the pursuit of a variety of behavioral problems, is planned in a later report. During the present study, the adult population of the captive colonies ranged between 63 and 124, which is smaller than that of large juvenile and adult colonies in the wild.

DESCRIPTION OF ALARM BEHAVIOR

When workers of *Pogonomyrex badius* are disturbed by alien mechanical or chemical stimuli, they show the following characteristic alarm response. *Low intensity*: rate of locomotion increases, with the ant moving in wide, poorly defined loops and circles; the head and antennae are periodically lifted high and the antennae waved about; the gaster may be periodically lowered so that its long axis is approximately perpendicular to the ground surface. *High intensity*: rate of locomotion increases still more, with the ant tending to move in tighter and more geometrical circling patterns; the head and antennae are periodically raised a moderate distance, but not as high as during lower intensity alarm; the mandibles are held partly open; the gaster may be periodically bent downward.

These two states of activity are not discontinuous but merely represent points on a gradient of intensity that is a function of the magnitude of the stimulus applied. Essentially the same pattern of behavior is exhibited both inside the artificial nest and outside it in the near vicinity of the nest entrance. Under laboratory conditions, the intensity of response outside the nest is inversely related to the distance of the locus of stimulation from the nest entrance. At the outer limits of the foraging arena, approximately one meter from the nest entrance, high-intensity responses have been difficult to induce, and workers have frequently shown instead a simple escape reaction.

A highly excited worker is a potential cause of a wave of alarm behavior among other workers. Under natural conditions a single worker exhibiting high-intensity alarm just outside the nest entrance can initiate general excitement that spreads centrifugally over the entire surface of the nest crater, along a radius of fifty centimeters or more. As the first worker commences a circling movement, it encounters other workers, which are stimulated to take up smiilar movement, in turn exciting other workers, and so forth. The wave of excitement seems to diminish in intensity away from the original stimulus in a roughly logarithmic fashion.

These results can be closely duplicated in laboratory colonies. When waves of excitement caused by a continuing stimulus at a single locus inside the nest are measured, a pattern of alternating expansion and contraction through the linear galleries is noted. The maximum range of the wave expansions is a function of the magnitude of the stimulus. During the first several minutes the maximum range achieved by successive waves tends to be stable. This is evidently due to the fact that expansions are ordinarily led by no more than one or two workers that break away momentarily from the zone of continuous excitement close to the stimulus; these individuals run outward, creating lesser, shorter-lived excitement among workers they pass, then turn back in the inevitable looping pattern that characterizes alarm behavior. After several minutes the workers in the zone of continuous excitement begin to adapt

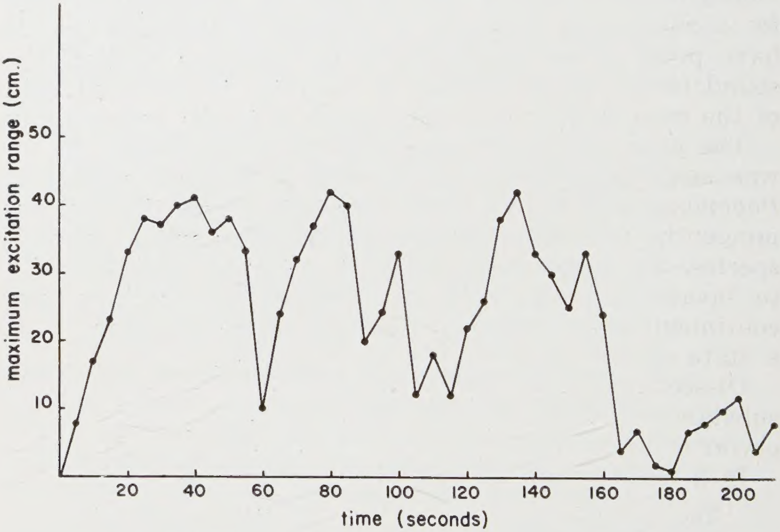


Figure 1. Spread of excitation through a laboratory colony of *Pogonomyrmex badius*. The continuing stimulus in this instance was an injured, immobile *Camponotus pennsylvanicus* (DeGeer) worker pinned to one spot in the nest interior. The maximum range of excitation was measured at five-second intervals in one direction only outward from the stimulus through the linear galleries of the artificial nest. Nest temperature: 30° ± 2° C. Further explanation in the text.

to the stimulus, the alarm behavior grows generally less intense, and the waves of expansion grow ever shorter (See figure 1).

THE RELEASE OF ALARM BEHAVIOR BY THE MANDIBULAR GLAND SECRETION

It has been noted repeatedly that purely mechanical stimulation of one worker by another is not ordinarily adequate to effect alarm behavior of significant intensity. Workers falling accidentally from the nest walls have been observed to push heavily against other workers without creating noticeable excitement. The same is true when injured workers occasionally manifest abnormally high locomotory activity for sustained periods and repeatedly bump against nestmates. Workers within the nest can also be pushed about lightly with clean glass rods, providing the ants are allowed to adapt to the immobile rods for a short time beforehand. Two other kinds of stimuli have proven most effective in eliciting alarm behavior: sound, especially that transmitted through the solid medium of the nest walls, and alien chemical substances.

The presence of a chemical releaser of alarm behavior was suspected when it was noted that greatly excited *Pogonomyrmex badius* workers discharge a highly volatile, pungently odorous substance. When workers of another species, *Solenopsis saevissima* (Fr. Smith), were allowed to invade a *badius* nest, the substance was discharged continuously for several hours and was associated with a state of high excitement among the *badius* workers.

Dissections of anesthetized workers revealed that the substance is concentrated, perhaps exclusively, in the reservoir of the mandibular gland of the head.[1]

In a majority of workers that have been removed carefully from the nest, anesthetized, and dissected, the gland reservoirs have been partly or completely filled with a colorless fluid. When the reservoir walls are ruptured this fluid evaporates within several seconds and the characteristic pungent odor can be perceived by the human observer over a distance of 50 centimeters or more.

---

[1] The morphology of the mandibular gland of ants has been described by Janet (1898) and more recently by Whelden (1957a, 1957b). As shown by these authors, the gland reservoir lacks constrictor muscles, and it seems likely that contraction is achieved through an increase in the surrounding hemolymph pressure. The gland and its reservoir are best exposed by splitting the head sagittally and removing the pharynx and associated tissues. Direct removal of the mandible by extraction almost always results in the collapse of the gland reservoir and loss of its contents.

The releaser effect of the mandibular gland secretion was demonstrated in the following way. When workers were seized with forceps and held about two centimeters above groups of resting workers just outside the nest entrance, alarm behavior was induced in the resting workers after an interval of several seconds. The captive workers were not stridulating, thus eliminating the possible complication of this additional stimulus, but they were releasing sufficient quantities of mandibular gland secretion to be discernible to a human observer a short distance away. Freshly killed workers, which were not producing discernible amounts of the secretion, elicited no response when held above resting workers.

When workers were crushed between two pieces of glass above groups of resting workers, large quantities of the mandibular gland secretion were released, and high-intensity alarm behavior was elicited. That the effect was in fact proluced by the mandibular gland substance and not by other substances released by crushing was tested in the following experiment. In separate trials various parts of an anesthetized worker were isolated and crushed above groups of workers in the manner described. Each body part was tested from a total of ten workers. The sequence of presentation was randomized to eliminate possible special sequential effects. Also, the trials were spread over a period of several days to reduce the decline of response due to adaptation. The results, presented in Table 1. show that the relatively minute mandibular gland produces more effect than any other part of the body, no matter how large. No attempt has been made to determine the extreme distance over which the contents of a single gland can act; the experiments described here suggest that it it not less than five centimeters at room temperature (26° C).

TABLE 1

LOCATION OF OLFACTORY ALARM RELEASERS IN *Pogonomyrmex badius* WORKER

Body part	Percentage of positive responses	Intensity of effect	Delay in onset of effect (range in secs.)	Duration of effect (range in secs.)	Duration of effect (M±s.e.)
entire head	100%	moderate to high	3-13	15-150	50.7±17.6
entire body minus head	30%	very low	4-8	10-15	13.3±1.4
mandible plus mandibular gland	100%	moderate	4-9	10-40	28.0±2.3
mandible alone	0	—	—	—	—
lateral half of head minus mandible and mandibular gland	0	—	—	—	—

Table 1. The effect on resting groups of workers of volatile substances artificially released from various body parts by crushing. Each selected part was separately crushed between two pieces of glass and then quickly exposed at a point four to five centimeters above groups of resting workers collected just outside the nest entrance. The results given in this table come from ten replications of the experiment. The lag in onset of behavior was measured to the nearest second, the duration of effect to the nearest five seconds. In the case of a negative response, the crushed material was held in position one minute before being withdrawn. In the course of dissection it was found expedient to leave the mandibular gland attached to the mandible in order to preserve the contents of the reservor intact. Further explanation in text.

The above observations show that the mandibular gland secretion from a single worker is adequate of itself to release alarm behavior. The social excitation waves characterizing alarm behavior in *Pogonomyrmex badius* are evidently propagated by means of excited workers exposing other workers to the secretion as they dash outward in their looping movements. Since the active component of the secretion is highly volatile, mass excitation tends quickly to die down when the primary external stimulus is removed. Finally, it is interesting to note that workers suddenly killed by predators under natural conditions are still capable of producing the alarm effect, since their secretion will be released when the head is crushed. One is reminded of the observation made commonly by students of ants (e.g., Carthy, 1951; Sudd, 1957) that crushed workers induce alarm or avoidance behavior in their nestmates. In the case of *Pogonomyrmex badius,* this effect can be ascribed specifically to the mandibular gland secretion.

THE RELEASE OF DIGGING BEHAVIOR BY THE MANDIBULAR GLAND SECRETION

During the experiments described in the preceeding section, it was discovered that workers exposed several times in rapid succession to mandibular gland secretion frequently began to show digging behavior. The complex motor activity involved appeared to be identical in all respects to normal digging behavior observed during "nest work", except that it tended to be undirected, i.e., unrelated to any particular topographic feature, and hence inconsequential in results. Excavation started in this fashion furthermore involved little interaction among workers, it ceased when the exposure to the secretion ceased, and it was not followed up by later nest work. No attempt was made to determine the primary causation of the behavior. At least two explanations seem possible: (1) prolonged exposure to the secretion induced the behavior directly, (2) the behavior was a physiological by-product of a prolonged state of excitement caused by exposure.

One is tempted to refer to the seemingly functionless digging behavior as a "displacement activity", in the sense employed by vertebrate ethologists (Tinbergen, 1951). It arises out of what can properly be called a conflict situation, during which workers become highly excited but encounter no object against which aggressiveness can be released. However, it should be noted that such behavior may well be functional under certain conditions. Experiments with substitute chemical agents, described in the next section, show that the digging becomes directional when the stimulus is confined to a single locus. It is probable that a worker buried by a cave-in will release mandibular-gland secretion; this becomes virtually certain if the cave-in is caused by the intrusion of some larger animal. As a result, it can be predicted that excavation following a major disturbance of the nest will tend to be directed toward those parts of the nest where workers are trapped. This hypothesis remains to be proven experimentally.

THE EFFECTS OF ALIEN CHEMICAL STIMULI

Apparently a wide variety of relatively volatile chemical agents are capable of inducing behavior patterns similar or identical to those released by the mandibular gland secretion. When groups of workers were allowed to come into direct contact with small amounts of formic acid, ethylamine, *n*-butyric acid or *n*-caproic acid absorbed in one- centimeter-square pieces of filter paper, they responded immediately with alarm behavior and in time with digging behavior. Further, the digging was concentrated around the paper squares. The ants made no attempt to remove the squares but instead tended to dig shallow trenches around them. When triethanolamine, ammonium sulfide, phenol, and oleic acid were tested in the same way, the ants either showed no reaction or (in the case of oleic acid) removed the paper square to the refuse pile of the foraging arena. When ethylamine and *n*-butyric acid were allowed to evaporate in the near vicinity of resting ants, so that these substances could be detected only by olfaction, the ants again responded with alarm and digging behavior. But in this case the intensity of the behavior was distinctly less than that following direct contact with the absorbed chemicals. It was also significantly less than that following exposure to comparable amounts of the evaporated mandibular-gland secretion.

SUMMARY

The secretion of the mandibular gland of the myrmicine ant *Pogonomyrmex badius* (Latreille) contains an unidentified component that acts as a releaser of both alarm and digging behavior. This substance is highly volatile, so that the contents of a single mandibular gland reservoir can act through the air over at least five centimeters; at 26° C alarm behavior was effected over this distance within four to nine seconds under the experimental conditions used. Highly excited workers discharge the secretion during the characteristic looping movements of alarm behavior and in so doing tend to set up waves of excitement that spread among other workers through the nest galleries and over the nest surface. Prolonged exposure to the secretion induces characteristic digging behavior, which may be directional if the stimulus is confined to a single locus. The hypothesis is advanced that directional digging thus induced functions at least in part to expedite "rescue" work following nest cave-ins. Similar alarm and digging behavior can be induced through the air by some other relatively volatile agents, e.g., formic acid, *n*-butyric acid, and ethylamine.

REFERENCES CITED

Carthy, J. D.
1951. The orientation of two allied species of British ants.
I. Visual direction finding in *Acanthomyops* (*Lasius*) *niger*. Behaviour, 3:275-303.

Goetsch, W.
1951. *Vergleichende Biologie der Insect-Staaten*. Akad. Verlagsges. Portig K.-G. (Leipzig). 479 pp.

Janet, C.
1898. Études sur les fourmis, les guêpes et les abeilles.
17. Système glandulaire tegumentaire de la *Myrmica rubra*. Carré et Naud (Paris). 28 pp, 9 figs.

Sudd, J. H.
1957. A response of worker ants to dead ants of their own species. Nature, **179**: 431-432.

Tinbergen, N.
1952. Derived activities: their causation, biological significance, origin and emancipation during evolution. Quart. Rev. Biol., 27: 1-32.
Whelden, R. M.
1957a. Notes on the anatomy of *Rhytidoponera convexa* Mayr (*"violacea"* Forel) (Hymenoptera, Formicidae). Ann. Ent. Soc. Amer., **50**: 271-282, 3 pls.
1957b. Notes on the anatomy of the Formicidae. I. *Stigmatomma pallipes* (Halderman). J. New York Ent. Soc., **65**: 1-21, 2 pls.
Wilson, E. O.
1959. Source and possible nature of the odor trail of fire ants. Science, 129:643-644.

MEXICAN SNAKE-FLIES (NEUROPTERA: RAPHIDIODEA)[1]

By F. M. Carpenter
Harvard University

The geographical distribution of the genera of snake-flies has been discussed in two previous papers (Carpenter, 1936, 1956). Up to the present time, only two (*Agulla, Inocellia*) of the four genera in the order have been found in the New World, although the other two (*Raphidia, Fibla*) are represented in Miocene deposits of Colorado.

The present paper is concerned with several specimens of snake-flies obtained from Dr. William W. Gibson of the Rockefeller Foundation, Jean Mathieu of the Instituto Tecnologico y de Estudios Superiores de Monterrey, Mexico, and Dr. Henry E. Howden of the Canada Department of Agriculture, Science Service. The two species represented are of unusual interest: one belongs to *Raphidia* and is, therefore, the first living species of this genus to be found in the New World; the other is an *Inocellia* possessing strongly pilose antennae — a feature not otherwise known in the suborder Raphidiodea.

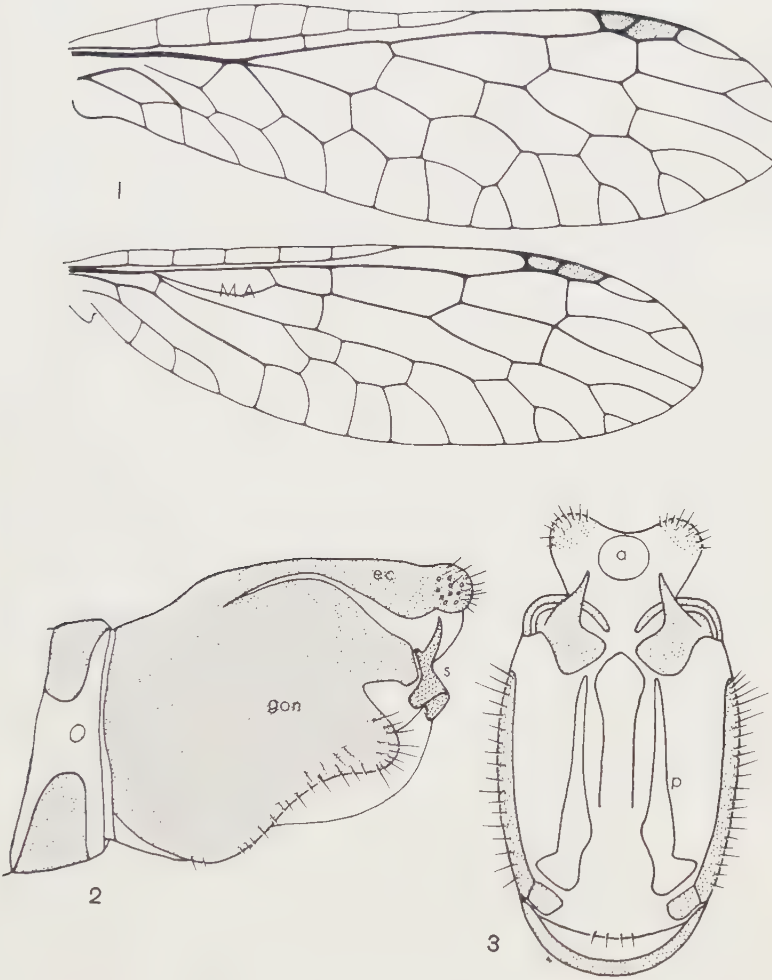
Family Raphidiidae

This family has previously been represented in the New World only by the genus *Agulla*. In addition to sixteen species occuring in parts of western United States and Canada, one species (*herbsti* Esben-Petersen) has been described from central Chile and two species have been described from Mexico. One of the latter (*australis* Banks) is known from San Lazaro in Baja California;[2] the other in southern Mexico. Specimens of the new species of (*caudata* Navas) was collected in the state of Guerrero

---

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

[2] The locality given in the published account (Banks, 1895) is "San Lazaro, Baja California," but the labels on the two cotypes (M.C.Z.) of *australis* read "San Lorenzo, Baja California."



Raphidia americana n. sp. All drawings based on holotype. Fig. 1. Fore and hind wings. Fig. 2 Terminal abdominal segments, lateral view. Fig. 3. Same, posterior view. Lettering: **MA**, stem of anterior media; gon, gonocoxite; s, stylus; ec, ectoproct; a, anus; p, paramere.

Raphidia were collected in southern Mexico, a little northeast of the *caudata* locality.

Raphidia americana, n. sp.

Plate 6, figures 1-3

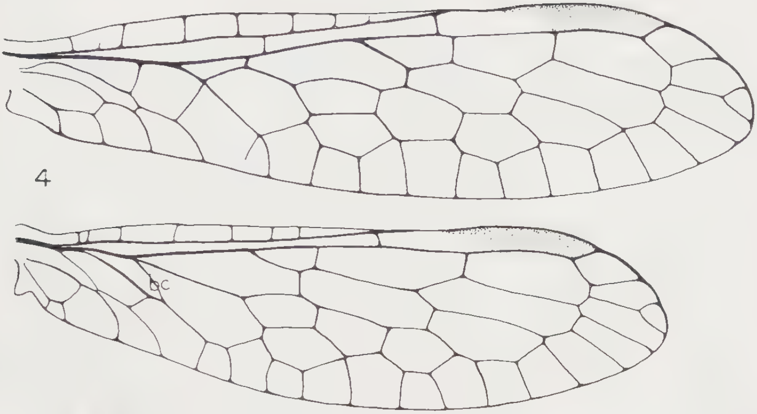
Male (holotype): length of fore wing, 6.4 mm.; width 2 mm.; length of hind wing, 6 mm.; width, 1.7 mm. Pterostigma about two and one-half times as long as wide. The general coloration and markings are typical of those of the genus; antennae, including first segment, yellow; head and prothorax black and reddish brown; thoracic tergites black, membranous areas of pleuron white; legs very light brown; abdominal tergites black, each with a white spot on the posterior margin near the outer edge of the sclerite; pleural membrane white; abdominal sternites brown, with a white patch posteriorly; wing veins nearly black; pterostigma yellowish, the proximal part somewhat darker than the distal. The terminal abdominal segments are shown in figures 2 and 3. The gonocoxites are firmly fused to the ninth sternite, forming a single, long, lateral plate; the styli are of moderate size, smaller than those of *notata*; the ectoproct is elongate, extending somewhat beyond the styli; the parameres are slender, weakly sclerotized plates closely pressed to the sides of the hypovalva.

Female (paratype): length of fore wing, 7.5 mm.; width, 2 mm.; ovipositor, 4 mm. The coloration and markings are similar to those of the males except for the antennae, the distal parts of which are dark brown (Antennal coloration is probably variable within the species).

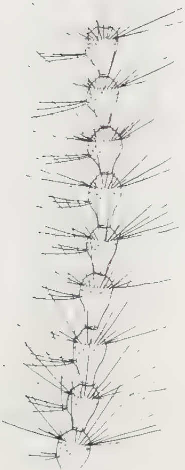
Holotype (♂): 5 miles north of Cuernavaco, Morelos, Mexico: 6000′ elevation; beating pine; Aug. 28, 1958 (collected by H. E. Howden). In the Canadian National Collection Department of Agriculture, Ottawa, Canada.

EPXLANATION OF PLATE 7

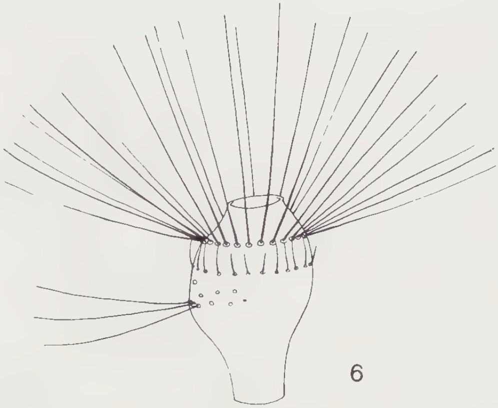
Inocellia pilicornis n. sp. All drawings based on holotype. Fig. 4. Fore and hind wings. Fig. 5. Part of an antenna. Fig. 6. A single antennal segment. Fig. 7. Terminal abdominal segments. Lettering: bc, basal crossvein.



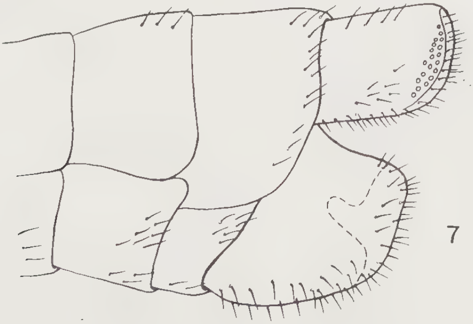
4



5



6



7

Carpenter — Snakeflies

Paratype (♀): Y.M.C.A. Camp, Tepaztlan, Morelos, Mexico; beating cypress; Aug. 21, 1958 (collected by H. E. Howden). In the Canadian Collection, Ottawa.

This insect clearly possesses the long piece of MA in the hind wing, characteristic of *Raphidia*, as opposed to its absence in *Agulla*. The species is readily identified by the fusion of the ninth sternite and its coxopodite into a single plate on each side. In *R. notata* of Europe the ninth sternite and coxopodite are partially fused, but in most species of the genus they are distinctly separated by a membraneous suture. It is interesting to note that a similar complete fusion occurs in some species of *Agulla* (e.g. *xanthostigma*), representing an independent and parallel development of this condition.

In other respects, *americana* is not notably different from other species of *Raphidia*. It differs from *notata* in having smaller styli and the absence of hooks on the gonocoxites of the ninth sternite.

As noted above, *americana* is the first known living species of *Raphidia* to be found in the New World, as that genus is now conceived (cf. Carpenter, 1936). In all probability it is a derivative of the original population of the genus that existed in the New World (at least in Colorado) in the middle Tertiary.

Family Inocelliidae

This family has previously been represented in the New World by two species of the genus *Inocellia*: *inflata* Hagen and *longicornis* Albarda, both of which occur in California, Oregon, Nevada, Washington, and British Columbia. The occurrence of the following new species in eastern Mexico is, therefore, of unusual interest.

Inocellia pilicornis, n. sp.

Plate 7, figures 4-7

Male: length of fore wing 8.7 mm.; width 2.3 mm.; length of hind wing, 7.5 mm.; width 2.2 mm. Pterostigma four times as long as wide. The veins and the pterostigma are light brown in the holotpye, but are very dark brown or even black in the paratypes. The markings on the dorsal surface of the head are typical of those of species in the genus: the anterior half dark brown or black, the posterior half lighter brown with four streaks of dark brown extending towards the posterior border. The antennae are light brown in the holotype but, except for the first two segments, are dark brown or black in the paratypes; the prothorax is brown to dark brown or black except for the anterior border, which is very light; the dark portion has the irregular dark and light brown markings characteristic of the genus. Mesonotum dark brown or black (paratypes) with a median, very light brown spot; mesoscutellum light brown; metanotum marked like mesonotum except that the median light brown spot extends to the anterior margin of the segment and includes some white. Abdominal tergites dark brown or black laterally, with a median light stripe extending continuously along all tergites; the light stripe is mostly light brown but includes some white at the anterior and posterior edges of the genus *Inocellia*. The antennae are 7 mm. long and consist of 60 to 61 moniliform segments; the individual segments (see figure 6) are asymetrical: on one side (the surface toward the other antenna) there is a cluster of three (rarely, four) long setae arising from nearly the same spot; this side of the antenna segment has a somewhat flattened appearance. Each antennal segment has a ring of 25 long setae, arising on the distal half of the segment; slightly proximally, near the middle of the segment, is a ring of 14 to 16 short setae which project distally. A few other setal sockets can be observed near the base of the cluster of three setae mentioned above. The terminal antennal segment is about twice as long as the others and lacks the peculiarities of the other segments; it bears about thirty setae. The prothorax is somewhat shorter than the head; the ectoproct has rounded posterior margins, somewhat as in *I. longicornis;* the gonocoxites of the ninth segment have the distal margin folded inward forming a curved tooth, which is similar to that in *longicornis.*

The female is unknown.

Holotype (♂): near Hidalgo, Tamaulipas, Mexico; March 27, 1938 (collected by C. C. Plummer). In the Museum of Comparative Zoology.

Paratype (♂): Monterrey, Neuvo Leon, Mexico; Feb. 26, 1956 (collected by Philip S. Barker); to be deposited in the collection of the Rockefeller Foundation Agricultural Program, Mexico, but temporarily placed in the Museum of Comparative Zoology.

Paratype (♂): 5 miles south of Monterrey, Nuevo Leon, Mexico; Sept. 3, 1958 ;night beating, Acacia-cypress area (collected by H. F. Howden). In the Canadian National Collection, Ottawa, Canada.

This species is at once distinguished from all other described species of the genus by the pilose, moniliform antennae. It is also noticeably smaller than the other species of *Inocellia* known from the New World, having a wing expanse of 17 mm. as compared with an expanse of 24 mm. for *inflata* and *longicornis*.

The inocelliid affinities of the new species are shown by the absence of ocelli, the absence of the basal pterostigmal veinlet, the presence of a forked posterior cubitus, and the oblique position of the vein *bc* (figure 4) in the hind wing. The species has the normal venational pattern of *Inocellla* (not that of *Fibla,* see Carpenter, 1936): in addition, the structure of the head, prothorax, and abdomen, including terminal segments, is typical of that of *Inocellia.* Hence, although the antennae (of the male, at least) are different from those of all other Raphidiodea, consisting of moniliform, pilose segments, I am assigning the species to *Inocellia.* Should the female turn out to have other characteristics which are equally peculiar, a separate genus will probably be needed for the insect.

LITERATURE CITED

Banks, N.

1895. Some Mexican Neuroptera. Proc. Cal. Acad. Sci. (2)**5**:514-522.

Carpenter, F. M.

1936. Revision of the Nearctic Raphidiodea (Recent and Fossil). Proc. Amer. Acad. Arts and Sci., **71**: 89-157.

1956. The Baltic Amber Snake-flies (Neuroptera). Psyche **63** (3):77-81.

THE COLLEMBOLA OF LEBANON AND WESTERN SYRIA
PART III FAMILY ISOTOMIDAE[1]

By K. Christiansen

Grinnell College, Grinnell, Iowa

The work herein described was done under N.S.F. Grant G 4563. I wish to gratefully acknowledge the work of my assistant, Jerry Tecklin, who did all of the preliminary sorting and most of the handling and mounting of the material here studied.

Relatively little has been known about the Isotomidae of the Syrian region. Until the work of Cassagnau and Delamare only a few of the more prominent epigeic forms had been described. With the above mentioned work the recorded species from the area were eight. In the present study four of these forms were recovered and two others were probably recovered. In addition 16 new records were established.

Anurophorus coiffaiti Cassagnau & Delamare
Plate 8, figures 6, 7

Anurophorus coiffaiti P. Cassagnau & Cl. Delamore, 1951 Biospeologica 75:377,378.

This species was the first of the genus to be described from Western Syria. The specimens at hand agree well with the illustrations and figures given by Delamare and Cassagnau. The P.A.O. (see figure 7) is characteristically oval with a definite indentation or indication of a listel at least on the forward margin. The abdominal thickenings chararacteristic of the species vary a great deal but some indication of these can be seen even in the youngest specimens. In some forms these fuse into a single large tubercle-like projection. The sense organ of the third antennal segment usually has only two short setae between the guard rods instead of three as indicated in the describers' illustration.

---

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

The species appears in the moist regions, largely in the mountains. Type locality Antelias Lebanon, x 9-51. Other captures: LEBANON: Ain Zhalte Cedars, 177 M., XI '52; B'charra Cedars, 1900 M. V '52; between Dhour Schweir and Bikfaya, VIII '53; Nahr Array between B'kassine and Jezzine, 800 M.; Wadi Jahnam (N.W. Tripoli Prov.), VII 31 '52; Bikfaya VII '53. SYRIA: Latakia Oak Grove, just below Turkish border, VIII '53.

Anurophorus asfouri, n. sp.

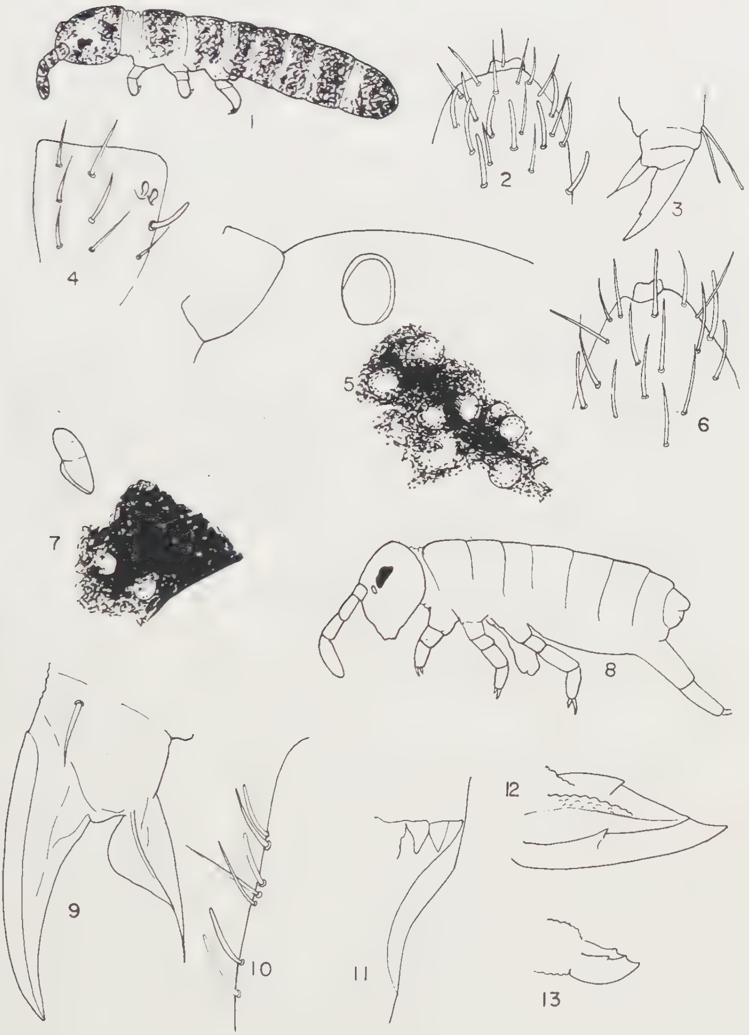
Plate 8, figures 1-5

Body subcylindrical with deep constrictions between segments. Unpigmented prothorax much wrinkled and about ½ as long as mesonotum. Clothing of body of relatively uniform short smooth acuminate setae, mostly curved with slightly longer straight setae on last three abdominal segments. Intersegmental membranes clearly demarcated except for fifth and sixth abdominal segments, which are solidly fused. Pigment blue, in scattered scabrous patches over head, antennae, and tergites. Intersegmental membranes and legs pale. Eyes eight per side on a medially constricted eye patch. Antennal apex with a large bilobed bulb set in a deep pit. Fourth antennal segment clothed

---

EXPLANATION OF PLATE 8

Figures 1-5: *Anurophorus asfouri* n. sp. 1. Habitus, paratype, seen from above and slightly to one side, setae omitted, 90×. 2. Tip of fourth antennal segment, paratype, 1000×. 3. Hind foot, paratype,1000 ×. 4. Third antennal segment "sense" organ, paratype, 1000 ×. 5. Eyes and P.A.O. right side, paratype, 700 ×. Figures 6 and 7: *A. coiffaiti.* 6. Tip fourth antennal segment, specimen from between Dhour Shweir and Bkfaya Lebanon, 1000 ×. 7. Anterior portion eye and P.A.O. Same specimen as above, 1000 ×. Figures 8-13: *Ballistura levantina* n. sp. 8. Habitus, setae and pigment omitted, paratype, 40×. 9. Hind foot, paratype, 1200×. 10. Inner margin of apex of fourth antennal segment, paratype, 1200×. 11. Inner part base of left dens showing dental projections, paratype, 1200 ×. 12. Right mucro seen from above and slightly to one side, paratype, 1200×. 13. Left mucro, side view, holotype, 380×.



CHRISTIANSEN — COLLEMBOLA

with a mixture of curved and straight acuminate setae, and a number of slightly curved blunt "sensory" setae. The latter type form about one third of the clothing of the apical half of the segment. Third segment clothed with a number of curved acuminate setae, and in addition six blunt setae as follows: on the dorsal surface two long rods enclose between them two short oval knobs (about one third as long as the rods); on the ventral surface there are two additional curved rods about one half as long as the dorsal ones. Second and first antennals segments each with a circlet of acuminate setae. P.A.O. broadly oval and more than twice as large as the largest eye. Eyes eight per side with eyes D, H, and E, being smaller than the remainder. Integument granulate save for the last two abdominal tergites which are finely reticulate. Legs with tibiotarsi subsegmented. Unguis without lateral teeth but with an extremely small inner tooth. Empodial appendage lanceolate, slightly less than half as long as unguis, and lacking any apical bristle. Unguis with three weakly clavate tenent hairs, the median being strikingly longer than the remainder.

The description of this form brings to four the number of species of *Anurophorus* having the fifth and sixth abdominal segments fused into a single mass. Although these species are generally similar they may be readily separated on the basis of the characteristics listed below:

SEPARATION OF SPECIES OF *Anurophorus* HAVING THE FIFTH AND SIXTH ABDOMINAL SEGMENTS FUSED

Species	P.A.O.	Organ eyes/side	ungual tooth
A. konseli	broadly oval	4	-
A. asfouri	broadly oval	8	+
A. oredonensis	narrow, indented	5	-
A. coiffaiti	narrow, indented	8 (7)	-

In addition to these, special characteristics such as the abdominal thickenings of A. *coiffati* and the antennal chaetotaxy can be used for additional separation.

Type locality: Kammouha LEBANON (25 specimens), 1900 M., VII 19 '52; also taken from Latakia, SYRIA, oak grove just below Turkish border, VIII '53.

Tetracanthella pilosa Schött

Tetracanthella pilosa Schött, 1891. Ent. *Tidskr.* **12**:191.

The specimens at hand agree with the descriptions and figures in Stach quite well. The only small difference noted was that the furcula was relatively longer. The species is quite rare in the region under consideration. It has been taken from: LEBANON: Ain Z'Halte Cedars, above forest, XI' 52; SYRIA: Pine Forest, Northern Latakia, VIII '53.

Folsomides americanus Denis

Folsomides americanus Denis 1931. Bul. Lab. Zool. Portici **26**:69-170.

I have nothing to add to the comments of Cassagnau and Delamare (*op. cit.*) concerning this species except that comparison with North American material shows it to be identical with the specimens at hand. This material had previously been identified as *Folsomides parvus.* The species is widespread and abundant through the lowland and lower mountain regions of the area under consideration. Taken from LEBANON: Beirut, campus American University, many dates from 1951 through 1953; Souk el Gharb, VIII '53, between Kfardebiene & Bskinta, V '53; Beit ed Dine, XI '53; Saida, XI '51; 14 Km. South of Saida, XI '53; 2 km. East of Rayak, VII '52; Farayha, V '53. SYRIA Latakia, oak grove just below Turkish border, VIII '53.

Folsomia

This genus is the best represented Isotomid genus in the area. There are probably five species occuring in the area, and the nature of the population isolation and variation within several of the species concerned merits a great deal more study. Cassagnau and Delamare (*op. cit.*) describe one new species and mention the capture of three single specimens they determined as *Folsomia ksenemani,* I feel certain that these were in fact single-eyed specimens of the same species I have identified as *F. penicula* Bagnall. For this reason I have not included *ksenemani* in the list below. It is quite probable that larger series in each case would have shown the more typical four-eyed forms in each population.

Folsomia quadrioculata Tullberg

Isotoma quadrioculata Tullberg, 1871. Ofv. Kongl. Vet. Akadm. Forhandl. **27** (1):143-155.

A great deal has been written about the group of species related to the form named above. Out of this there has developed a welter of species: *brevicauda, quadrioculata, manolachei, nana, microchaeta, penicula and multiseta.* Further than this when we considered the excellent work of Agrell upon variation in eye number we can add to this group at least the one-eyed forms such as *regularis, diplopthalmia, agrelli, ksenemani, pseudodiplopthalma, similis,* and *monopthalma.* Most of these so-called species differ by very few characteristics, indeed often only by one. These are commonly chaetotaxy differences and there is not the slightest bit of evidence to deny the possibility that they represent single gene variations. Thus the differences seen could well represent in some cases balanced polymorphism, and in others ecotypical selection for a given gene. Further than this most of the species here mentioned have been studied at one time from a few relativley homogenous habitats and there is thus little opportunity to study the variation through a wide range of conditions. I wish to suggest that there is at present insufficient evidence to sort out accurately from the forms mentioned above more than a few forms and be able to say with any degree of assurance that they actually represent different species. The specimens studied below appear to be classifiable as two species, *F. quadrioculata and F. penicula.* If we accept this thesis, then it is possible to sort out the specimens at hand quite readily on the basis of the ventral manubrial chaetotaxy. If we sort them out thus, it appears that with few exceptions a given collection or sample is of one form or the other. If an attempt is made to sort out the populations on any other basis, this is not so and most samples are mixed. Further, in a statistical sense it is possible to sort out these two species upon about five additional characteristics; however, none of these shows very good correlation with the manubrial chaetotaxy. For purposes of illustrating the distribution of some of these characteristics through the population, a large number of specimens from twelve localities was sorted out to *quadrioculata* or *penicula* on a basis of the ventral manubrial setae. Fifteen specimens were chosen from each species and checked for a number of characteristics. The results are indicated below.

Description of character	*% quadrioculata* having	% penicula having
Eyes unequal in size	47	86
Largest setae posterior margin head twice smallest	33	100
Brush-like mass long setae (4-5 rows) at end abdomen	73	100
Gap of P.A.O. wider than lip	93	47
Dentes with median dorsal seta	47	93

Other differences examined (ex., angling P.A.O. dorsal chaetotaxy, occurence one-eyed forms, shape of mucro) showed even less differentiation, or differences so fine as to be impractical. In many populations of both species an occasional one-eyed form is to be found, and a few populations consist of such forms exclusively, without differing in any other visible respect from the four-eyed populations.

The net result of this is to indicate that in the region studied there are two forms separable upon a basis of their manubrial chaetotaxy. It is convenient to consider them as two species but it must be understood that the real nature of their genetic relationship has yet to be established.

In the Western Syrian region *penicula* is widely distributed throughout the Lebanese mountains and the coastal plain, whereas *quadrioculata* is largely limited to the higher elevations of the Lebanon Mountains.

Distribution of *quadrioculata*: LEBANON: Ain Z'Halte Cedars, 1700 M. VII '52 & XI '52; between K'Fardebiene & Beskinta, 1900 M., VI '53; Hadeth Cedars, 1700 M., VII '53 B'Charra Cedars, 1900 M., V '53; Barouk Cedars, 1700 M.. VI '53.

Folsomia penicula Bagnall

Folsomia penicula Bagnall 1939. Ent. Mo. Mag. **75**:56-59.

Folsomia tetropthalma Gisin 1946. Mitt. Scweiz. Ent. Ges. **20**:219. (New Synonymy).

Folsomia multiseta Stach 1947. Acta Monographica Polska Akademia umiejetnosci **138**:172-177. (New Synonymy).

Penicula was described for forms having two pairs of eyes with the posteriormost pair smaller than the fore pair and having a brush-like mass of setae at the end of the abdomen. In addition to this the members of the species are characterized by having six or more ventral manubrial setae in adult animals. In 1946 Gisin pointed out that this species was probably identical with Kseneman's F. *diplopthalma* var. *Tetropthalma.* Since Kseneman had indicated that in his opinion this was a matter of population variation and thus not subspecific in rank, this name would fall under the category of "infrasubspecific form" according to the rules "A name given to any infrasubspecific form if elevated to subspecific or specific rank by a subsequent reviser shall rank in its new status for purposes of priority as from the date on which it was so elevated, and shall be attributed to the author by whom it was so elevated." Thus *Folsomia tetropthalma* becomes a junior synonym of *F. penicula.*

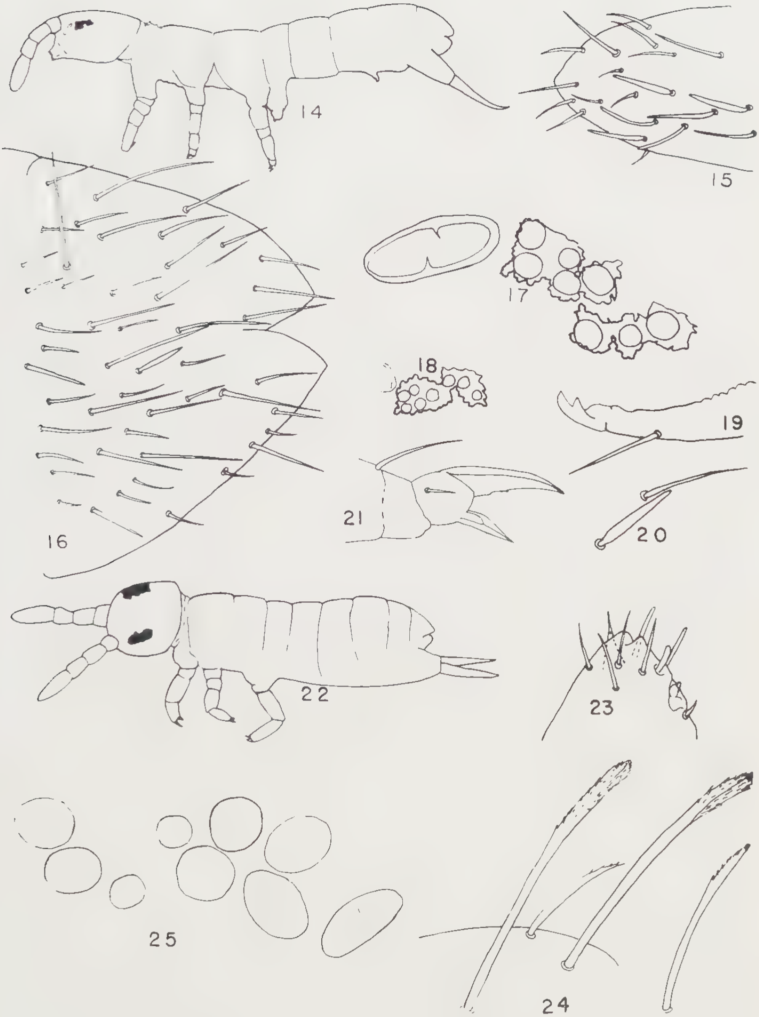
The species is extremely common in Lebanon and Syria, and in a variety of habitats. The specimens at hand display characteristics which destroy the separation shown between this species and *multiseta* by Stach (1947). The table below indicates how this species violates both sets of limitations:

	penicula acc. Stach	multiseta acc. Stach	Leb. penicula
Ventral maubrial setae	12-13	14-17	11-16
P.A.O./ommatidium	3.5-4	4-5	3.5-6
ventral setae on dens	12	16-22	12-18

In view of this I feel best to consider *multiseta* a synonym of the locally variable *penicula.*

EXPLANATION OF PLATE 9

Figures 14-21: *Isotomina salaymehi* n. sp. 14. Habitus, specimen from Beirut, 90 ×. 15. Tip of fourth antennal segment, paratype, 1200 ×. 16. Chaetotaxy last two abdominal segments, side view, paratype, 600 ×. 17. Eyes and P.A.O. Unusual specimen with complete division eye patch, paratype, 1200 ×. 18. Eyes and edge P.A.O. showing normal condition, paratype, 600 ×. 19. Right mucro, paratype,1100 ×. 20. Abdominal "sensory" seta with neighboring normal seta, ptaarype, 1100 ×. 21. Hind unguis, paraytpe, 1200 ×. Figure 22-25: *Vertagopus ciliatus* n. sp. 22. Habitus (slightly distorted by mounting) paratype, 90 ×. 23. Apex fourth antennal segment, holotype, 1200 ×. 24. Long ciliate setae of fifth and sixth abdominal segments, holotype, 1200 ×. 25. Eyes and P.A.O. left side paratype, 1200 ×.



CHRISTIANSEN — COLLEMBOLA

One last point which must be discussed is the variation in the number of eyes. Agrell, Kseneman, Stach and a number of other investigators have accepted the fact that the number of eyes in at least some species of *Folsomia* is varible. Gisin in 1946 has stated that this condition has not been proven for any species of the genus. Among the specimens I have identified as *F. penicula* are occasional specimens with a single pair of eyes, and in one case a specimen lacking eyes entirely. Beyond this, an occasional (2) small sample may consist of all one-eye paired forms. In all cases, and particularly where the four-eyed and two-eyed forms occurred in the same population, a slow, careful comparison was made between the two-eyed and four-eyed forms and not the slightest difference other than the eyes could be found. To assume that these represent different species, particularly where the one-eyed paired forms represent two specimens in a sample of thousands, is to my view sheer folly. I feel therefore that I can state with authority that in the species I call *penicula* there are both two-eyed and four-eyed forms. The two-eyed forms are undoubtedly synonymous with those specimens identified by Cassagnau as *Ksenmani*. It is entirely possible that these two species are synonyms but before this can be ascertained the whole group must be thoroughly reviewed.

Distribution: LEBANON: Ain Z'Halte Cedars, many dates; B'Charra Cedars, V '53; Kammouha, VIII '52; Barouk Cedars, VI '53; Chamlane, XII '53: Vic. Beit ed Dine, XI '53; Beirut, American University campus, many dates. SYRIA: North Latakia pine forest, VII '53; Latakia, oak grove just below Turkish border, V '53.

Folsomia candida Willem

Folsomia candida Willem 1902. Ann. Soc. Ent. Belgique, **46**:275-283.

The specimens at hand agree very well with the figures and descriptions given in Stach. The only notable difference was the absence of an inner tooth on the unguis. In this respect the present specimens are similar to Bagnall's *distincta,* but I agree with Stach that there is insufficent grounds for separating this species at the present time. The evidence of Delamare (1950) and this material point to a locally variable widespread form. The present specimens are similar to the forms described and figured from Ardeche by Delamare in the absence of an inner tooth and the proportions of the dens, as well as in the existence of an occasional triangular P.A.O. However, in the chaetotaxy of the manubrial venter and the structure of the unguis, the present specimens are much more like those figured by Stach for *candida.*

Distribution: LEBANON: Beirut, campus American University, V '52; between Jezzine and B'Kassine, IX '52; Hermel, VII '52; Kammouha, VIII '52.

Folsomia cavicola Cassagnau & Delamare

Folsomia cavicola P. Cassagnau & Cl. Delamare Deboutteville *op. cit.* :381,382.

I have not recovered this species but it appears to be distinguished from *candida* in Lebanon by the absence of an apical filament on the unguis, presence of a large internal ungual tooth, and the blunt mucronal teeth. Also the apical tooth is strongly upcurved in contrast to the straight tooth of *candida.* Known only from Ghita cave.

Folsomia sp.

A single specimen taken (damaged) from the Nahr Array in Lebanon merits mention. The P.A.O. is divided by a prominent listel, and the last three abdominal segments are weakly fused. The furcula is short and the mucro three-toothed. The eyes appear to be eight/side but are hard to distinguish. While this is probably a new species of *Folsomia* the single damaged specimen is insufficient material for its description.

Proisotoma minuta Tullberg

Isotoma minuta Tullberg 1871. *op. cit.* :143-155.

The specimens at hand appear quite similar to those described and figured by Linnianemi, and Stach. There appears to be some variation in the setae on the tenaculum (most of the present forms have two setae) and in the eyes. In a number of specimens it appears that eyes G. and H are definitely smaller than the remainder. The size of the basalmost mucronal tooth is variable.

Distribution: LEBANON:Hermel, VII '52; 2 Km. N. of Saida, XI '53; Antilias, XI '52 Nahr Array, V '52; Beirut, American University campus. SYRIA: Latakia, below Turkish border, Oak Grove, VII '53: North Latakia pine forest

Proisotoma minima (Absolon)

Isotoma minima Absolon 1901. Zool. Anz.24 (634): 32,33.

Only three specimens were recovered from one locality: Lebanon: Aaranita, VII '52.

Ballisrura schötti Dalla Torre

Proisotoma schötti (Dalla Torre) 1885, 46 Progr. St. Gymn. Innsbruck.

Handschin recorded this species from Palestine.

Ballistura levantina, n. sp.

Plate 8, Figures 8-13

Facies *Hypogastrura*-like. Body and appendages thick. Uniformly blue-black in color except for slihgtly paler legs. Clothing of trunk and head of smooth, short curved setae of relatively uniform length. Sixth abdominal segment with a dozen longer setae about twice to three times as long as the shortest setae of the same segment. Antennae slightly but definitely longer than head. Fourth antennal segment without apical bulb, clothed with a variety of short, smooth setae. These are of three main types, straight to curved acuminate setae, straight truncate setae, and long mostly curved blunt "sensory" setae. In addition the dorsal surface bears a short triangular spine-like seta in a clear pit. Sense organ of third antennal segment of two oval central pegs, one of which is strongly curved. Remainder of antennae clothed with normal acuminate setae. P.A.O. elliptical, eyepatch. Tibiotarsus without subsegment. Tenent hair not clavate and unguis untoothed. Empolial appendage with large inner basal lamella and clear apical filament. Manubrion without ventral setae and with numerous torsal setae. Dentes thick but tapering. Mucro boat shaped with thick granulate central axis, and with toothed lateral lamellae. Mucro from site view very deep, more than ½ as deep as long. Tenaculum with four teeth and a single bristle. Corpus with an anterior projection much longer than the rami.

The species is similar to *B. crassicauda* in most respects. The differences between the two species are all small but in accumulation they indicate a real difference. Since previous abundant records of the group have shown little variation I feel the differences listed below merit specific separation.

Character	*crassicauda*	*levantina*
mucro	less than ½ as deep as long	more than ½ as deep as long
manubrium	with 4 ventral setae	without ventral setae
4th ant. seg.	without blunt "sensory" setae	with clear blunt "sensory" setae
3rd ant. seg. "sense organs"	peg-like, subcylindrical	oval
longest abdominal setae	1.5 × smallest	2-3 × smallest

There is some variation in the P.A.O. of the present species. In most specimens the margins are entire but a few show clear indentation in one or both margins. In most respects there is almost no variation in the large series seen.

Known only from type locality: Lebanon: Kadischa cave; moss near spray zone of waterfall near mouth, v '53 (30 specimens).

Isotomina bituberculata (Wahlgren)

Although the original description was not seen the specimens at hand agree very well with the available descriptions. The eye number is six per side. Some specimens have the eyes so heavily pigmented as to be difficult to count but observation during clearing with Potassium Hydroxide showed the actual number to six in every case examined. The posterior abdominal setae are unusually long in adults varying from .045 to .066 mm. This may very well be the same species described by Cassagnau and Delamare as *Isotomina pontica.* In some small specimens the median eyes are invisible until clearing is complete and this might account for the difference in identification. Distribution: Lebanon: 2 km. E. Rayak, vii '52; Hadeth, vii '53; below Bakich, v '53; 14 km. S. Saida, xi '53. Syria: Northern Latakia pine forest, vii '53.

Isotomina pontica Stach

Isotomina pontica Stach 1947. Acta Monog. Polska Akademia Umiejetnosci: 267.

Cassagnau and Delamare reported this from 3 localities:

Grotte d'Amchite, Roum, and Source de Hasbani. See the discussion above.

Isotomina salaymehi, n. sp.

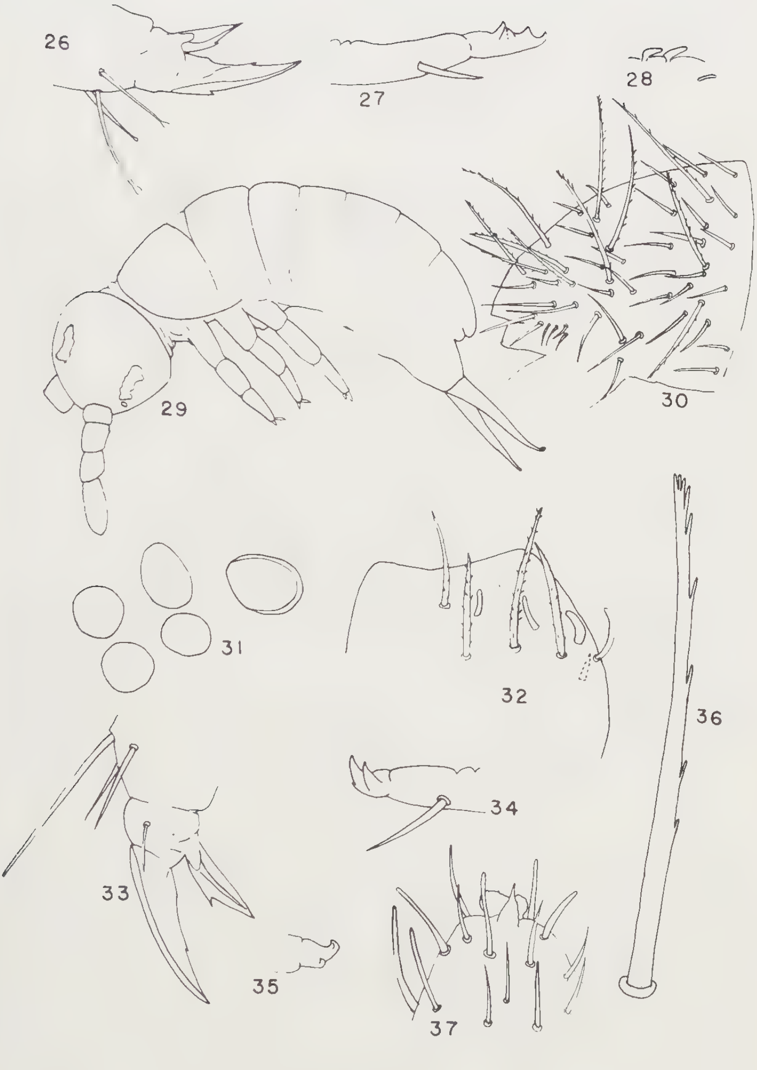
Plate 9, figures 14-21

Body subscylindrical with last two segments solidly fused. Furcula reaching posterior border of second abdominal segment. Pigment gray, in the form of scattered granules. Eyepatches black and medially constricted. Fourth antennal segment clothed with numerous curved and straight acuminate setae. Six of these are basally slightly expanded and notably thicker than remainder. Third antennal segment with two short "sensory" oval knobs set by short stalks in separate pits. On either side a narrow rod. Remainder of antennae clothed with slightly curved to straight acuminate smooth setae. Thorax and first four abdominal segments clothed with short acuminate smooth setae, recumbent except for a single row of erect setae on the third and fourth abdominal segments. Fused fifth and sixth segments clothed with acuminate setae of various sizes, the longest 3 times as long as the shortest. In addition a single blunt "sensory" setae can be seen in the posterio-lateral quadrant on each side. Eyes eight per side with eye D strikingly smaller than remainder. Legs unpigmented with incomplete but distinct subsegment on at least one pair of tibiotarsi. Unguis with minute inner tooth but without lateral teeth. Empodial appendage

---

Explanation of Plate 10

Figures 26-28: *Vertagopus ciliatus* n. sp. 26. Right fore foot, holotype, 1000 ×. 27. Right mucro, holotype,1000 ×. 28. Third antennal segment "sense" organ, paratype, 1200 ×. Figures 29-37: *Pseudisotoma* (*Isotomida*) *anamola* n. sp. 29. Habitus (slightly compressed in mounting) holotype, 90 ×. 30. Fused fifth and sixth abdominal segments, paratype, 300 ×. 31. Right P.A.O. and anterior four eyes, paratype, 1200 ×. 32. Third antennal segment sense organ, paratype, 1200 ×. 33. Right hind foot, paratype, 1200 ×. 34. Mucro, side view, paratype, 1200 ×. 35. Mucro seen from above, holotype, 1200 ×. 36. Large ciliate seta from fig. 30 showing peculiar ciliation, 1200 ×. 37. Tip fourth antennal segment, holotype. 1100 ×.



Christiansen — Collembola

acuminate, with striking central ridge, and basal part inner lamella expanded. Tenent hair acuminate. Tenaculum with four teeth and single large basal seta. Manubrium with one pair of ventral and 24 dorsal setae. Dens with a double row of ventral setae, and four dorsal setae. Mucro with two teeth and straight ventral margin.

Discussion

This species can readily be separated from all described species of *Isotomina* by the well developed blunt "sensory" seta on the last abdominal segment. In other respects this species seems to be most closely related to *I. thermophila*, but it may also be separated from this species by the small eye D, by the presence of a tibiotarsal subsegment, and by the fact that the longest abdominal setae are three times as long as the shortest.

The present species shows a good deal of variation, particularly in respect to the eyes. The eye D is usually considerably smaller than the remainder but in a few specimens it is entirely absent. The eyepatch shows some tendency towards constriction in the middle, and in a few specimens it is actually divided into two patches. The clarity and presence of the tibiotarsal subsegment varies a great deal although most specimens show this on the third pair of legs.

Type locality: Antelias, Lebanon, XI '52. Other collections: LEBANON: Vic. Nabeth Safa, XI '53; Beirut, American University campus, V '52; Barouk Cedars, VI '53; 2 km. E. Rayak VII '52. SYRIA: S. Latakia.

Vertagopus aborea Linne

Podura arborea Linne 1758. Systema naturae Edit. 10 Holmiae: 609.

The specimens at hand agree well with available descriptions and specimens except for two things: first, the color is not dark purple or purple blue but medium to pale gray-blue. Second, the fifth and sixth abdominal segments have setae twice as long as the shortest setae of these segments. As Stach points out, from the varied descriptions of this form it would appear that either a species complex or a geographically variable form is involved. In view of the general similarity of the present specimens with European members of this species, I consider it best to place them in the same species. In the region it appears to be rare and only in the cedar forests. Distribution: LEBANON: B'Charra Cedars, V '53; Barouk Cedars, VI ,53; Hadeth Cedars, VII '53.

Vertagopus ciliatus, n. sp.

Plate 9, figures 22-25; plate 10, figures 26-28

Body subsylindrical, furcula reaching posterior border of second abdominal segment. Antennae clearly longer than head and slightly longer than furcula. Pigment dark blue in scabrous patches over antennae, head and body tergites. Legs, furcula, and venter light blue. Fourth antennal segment with two prominent apical humps and a single apical cone bearing a stout acuminate seta. Just below antennal apex a single stout curved rod and below this a distinct pit containing a spherical knob with a short curved conical seta on its basal margin. Outer margin of segment with two irregular rows of curved blunted setae. Third antennal segment "sense organ" of two strongly curved thickened knobs without clear protective setae. Remainder of antennae clothed with numerous curved and straight acuminate smooth setae. Fourth abdominal segment similar except for the posterior two rows of setae which are apically unilaterally ciliate. Fifth segment clothed with similar setae with the addition of a single row of long cylindrical setae, blunt and apically finely ciliate. Sixth segment with three rows of long setae, the anterior row similar to those of the fifth segment, the posterior two rows somewhat more acuminate. Tibiotarsus with three clubbed tenent hairs, the median strikingly longer than the others. Unguis narrow, with small internal and pronounced lateral teeth. Empodial appendage lanceolate with minute corner tooth. Eyepatch solid, eyes eight per side with eyes G and H smaller than remainder. P.A.O. oval, about as long as one large eye, with faint indication of transverse listel. Tenaculum with four teeth and five setae on corpus. Manubrium with fifteen ventral setae as follows: two transverse rows of three near apex and two converging longitudinal rows of four setae joined at a basal median seta. Dens with numerous stout acuminate ventral setae and four slender dorsal ones. Mucro with four teeth, apical projecting forward and slightly smaller than remainder which are subequal.

Discussion

This species appears to be most closely allied to *V. cinerea* but it may readily be separated from that species on the basis of the structure of the third antennal organ, the structure of the eyes and the peculiar abdominal setae. These setae occur on both adult males and female. These setae would appear to separate it readily from all described species of the genus. The P.A.O. usually shows some indication of a dividing listel but this may be entirely absent.

Known only from the type locality, Kammouha Spruce Forest, VIII '52,, LEBANON (8 specimens).

Pseudisotoma (Istomidia) **anamola**, n. sp.

Plate 10, Figures 29-37

Facies isotomine. Fourth antennal segment with apical bilobed bulb and striking conical projection bearing a stout acuminate seta. Apical half of segment with a number of slightly blunted curved setae somewhat larger than remaining setae which are acuminate, smooth, curved or straight. Remaining antennal segments clothed with slightly curved mostly sparsely ciliate acuminate setae of differing sizes. Third antennal segment organ of three thick short cylindrical pegs of varying diameter, the median being the largest. In addition there is a somewhat longer slender rod. All of these are situated in a straight line without protecting folds or pits. A small conical seta is located on the opposite surface of the segment. Head and body clothed with a variety of slightly curved to straight acuminate setae. The smaller ones are smooth but the larger setae on the thorax and abdomen are unilaterally sparsely ciliate. Eyes eight per side with the anterior two larger than remainder. P.A.O. broadly oval, about as long as one forward eye. Setae of legs acuminate smooth, those on femur sparsely striate. Unguis with minute median internal tooth and distinct lateral teeth. Empodial appendage lanceolate with a clear inner corner tooth. Tenent hairs acuminate. Tenaculum with four teeth, corpus without setae. Fifth and sixth abdominal segments fused, remainder distinct. Manubrium slightly less than half as long as dens, dorsally with numerous setae, ventrally with a single pair of large setae near the base of the dens. Dens ventrally with numerous short acuminate setae, and dorsally with six slender short setae. Mucro short, with two large curved teeth and a minute apical tooth.

Only a few specimens of this unusual species were seen and all of these were apparently immature. The head body ratios and general condition of the animals would indicate that they were nearly adult and thus while significant change in some organs with growth cannot be ruled out (ex., manubrial chaetotaxy) it seems likely that the major characteristics described above will hold for the adult animals. The discovery of this species poses some interesting questions. If we accept the commonly used distinction between Proisotominae and Isotominae — i.e. two or less manubrial setae on venter — then this species would be in the Proisotominae and close to the genus *Isotomina* or *Proisotoma*. However, in all other structures the animal shows a clear relationship to the Isotominae, and has nothing in common with the genera mentioned above save the manubrial chaetotaxy. In the Isotominae it would appear to fall into Salmon's genus *Isotomidia*. This genus was created for species generally similar to *Pseudisotoma* except for the lack of clavate tenent hairs and the presence of papillae on the antennae. Stach, apparently feeling that this insufficient grounds for separation, placed this as a synonym of *Pseudisotoma*. The present species fits the criteria for *Isotomidia* except for the absence of the antennal papillae, and further differs from *Pseudistotoma* by the presence of an apical biloped bulb, and the single pair of ventral manubrial setae. In his description of *Isotomidia triseta* Salmon (1944) says "A few isolated setae occur on the manubrium . . . " and in his figures he shows what might be considered an apical bulb. In view of this and the differences between the two forms I have thought it best to consider *Isotomidia* a subgenus of *Pseudistoma* until a thorough study of all the forms can be made.

The species has been taken from two localities in

Lebanon: Type locality: Wadi Jahnam (N.W. Tripoli province), VII '52 (2 specimens). Also taken from 2 km. E. Rayak, VII '52.

Isotoma notabilis Schaeffer

Isotoma notabilis Schaeffer 1896. Mitt. Naturh. Mus. Hamburg 13:187.

The specimens at hand agree well with available descriptions and specimens of the species. A few minor chaetotaxy differences could be seen, notably the absence of a pair of long setae on the second and third abdominal segments. A few specimens showed three eyes per side rather than the normal four. The species is widespread throughout Lebanon and Latakia but is oddly absent from the coastal plain area.

Distribution: LEBANON: Hadeth Cedars, VII '53; B'Charra Cedars, IV '53, Ain Z'Halte Cedars, VII '52 & XI '52; Kammouha, VII '52; Barouk Cedars, VI '53; below Bakich, V '53; Souk el Gharb, VIII '53; Vic. Beit ed Dine, XI '53; Bikfaya, VIII '53; 2 km. E. Rayak, VII '52; Antelias source, XI '52; Rahbeh B'kaa, IX '52. Syria: Latakia, oak grove below Turkish border.

Isotoma viridis Bourlet

Isotoma viridis Bourlet 1839. Mem. Soc. Roy. Sci. Agric. Arts Lille :401.
Isotoma turkestanica Stach 1947. *op. cit.* :355, 366. (New Synonymy).

The specimens agree on the whole very well with figures, descriptions and specimens previously identified as this species. Certain variations are worthy of note. First there are on most specimens clearly visible fine ciliate setae on the dens. In addition to this about half the specimens have the anteapical teeth not on a level. A last character of note is the p.a.o. In most, but not all, specimens this organ has a thickened margin of irregular shape. The pattern of the specimens is either of the type called *decorata* by Brown or in the form of stripes across the posterior margins of the segments.

The occurrence of the ciliated dental setae and the displaced anteapical tooth raises a serious question in connection with Stach's *I. turkestanica*. This form, briefly described in his key and without figures or further description in the text, differs from *viridis* by the occurrence of ciliated setae on the dens and the feet. In addition he mentions the fact that the anteapical teeth are not on a level. In the specimens seen here the ciliate setae can be seen on the dens but not the legs while the teeth may or may not be level. In addition there is the variation in the structure of the P.A.O. not mentioned before. When we combine this with the well known local variability of the pattern in *viridis* I feel it best to consider *turkestanica* and the present form part of the locally variable widespread *I. viridis.*

In the region it has been found only from the Lebanon Mountains: LEBANON: B'Charra Cedars, V '53; Vic. Harrisa, XI '52; Ain Z'Halte Cedars, VII '52 & XI '52. Cassagnau & Delamare reported it from Chebaa and Handschin from several localities in Palestine.

Isotomuris palustris Muller

Podura palustris Muller 1776. Zoologicae Daniae Prodremus :184.

The specimens agree well with available descriptions of European forms identified as this species, A number of minor differences are seen: there are frequently no ciliate macrochaetae on the third abdominal segment, and the corner tooth on the last two pairs of empodial appendages is absent in about 85% of the animals. The patterns are varied. Distribution: LEBANON: 2 km. S. Saida, XI '53; Ain Z'Halte, XI '53; Ain Z'Halte Cedars, V 'EC; Kammoutha, VIII '52; Vic Quaaranita, VII '52; Wadi Jahanem (N.W. Tripoli province), VII '52; Vic. Beit ed Dine, XI '53; Harajel, XI 'EB; Chamlane, XII '53.

Literature Cited (see also parts I and II)

Agrell, I.

1939. Ein Artenproblem in der Collembolengattung *Folsomia.* Kungl. Sall. Forh. **9** (13) :1-14.

1948. Studies on Postembryonic development of Collemboles. Arkiv. Zool. Kongl. Svensk. Vet. 41 (12):1-35.

Delamare Deboutteville, Cl.

1950. Notes faunistiques sur les Collemboles de France. VII. Collemboles de la Grotte de la Balme. Bull. Mens. Soc. Lnn. Lyon 19(6):122,123.

Gisin, H.

1942. Materialen zur Revision der Collembolen: I. Neue un Verkannte Isotomiden. Rev. Suisse de Zool. 49 (20):288-290.

1944. Materialen zur Revision der Collebolen. II. Weiteres Basaler Material. Mitt. Schweiz. Ent. Ges. **19**(4-5) :21-25.

1946. Collemboles nouveaux ou peu connus de la Suisse. Mitt. Schweiz. Ent. Ges. **20**(3) :219,220.

1957. Sur la faune europeene des Collemboles. I. Rev. Suisse de Zoologie **64**(25) :486-488.

Kseneman, *M.*

1936, Zur Bestimmung aller bisher bekannten Arten der Gattung *Folsomia* Willem. Sborn. Cs. Acad. Zemed. Prague **11**:210-219.

1936. Diagnosen neuer Collembolenarten aus Mitteleuropa. *Op. Cit.* :101-108.

Linnaniemi, W. M.

1912. Die Apterygotenfauna Finlands. II. Spezialer Teil. Acta Soc. Sci. Fenn. **40**(5) :1-352.

Salmon, J. T.

1944. New Genera, Species and Records of New Zealand Collembola. Rec. Domin. Mus. **1**:123-182.

THE INDO-AUSTRALIAN SPECIES OF THE ANT GENUS STRUMIGENYS FR. SMITH: GROUP OF *S. GODEFFROYI* IN BORNEO[1]

By William L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

This paper is a further contribution in a series which, when complete, will cover the known species of the Indo-Australian portion of the dacetine ant genus *Strumigenys* Fr. Smith. For general background, explanations of abbreviations used in citing measurements and indices, and discussion of *S. godeffroyi* Mayr and related species, see Brown, 1949, *Mushi* 20: especially pp. 2 and 16-19. Previous parts of this series, the first two of which also include explanations of abbreviations for measurements, etc., are in *Psyche* 60: 85-89 (1953), 60: 160-166 (1954), 61: 68-73 (1954), 63: 113-118 (1956), and 64: 109-114 (1957). Figures of these species have been prepared, but are being saved for use in collective plates in connection with the eventual keys to all the Indo-Australian species of the genus.

I have seen a dealate female of *S. godeffroyi* Mayr from Long Navang, northern Borneo, E. Mjöberg leg. This species probably occurs at many coastal points and around settlements inland. It is widespread in the tropics of southeastern Asia and the Pacific.

The following five species evidently are much more local and rare.

Strumigenys dyak sp. nov.

Holotype worker: TL 3.07, HL 0.80. ML 0.35, WL 0.80 mm.; CI 69, ML 44. Close to *S. solifontis* Brown, from Japan, but differing chiefly in the shorter and straighter mandibles, and in the long preapical tooth being set only a little more than half its own length away from the dorsal apical tooth. The size, proportions of the head, and shape of alitrunk are

---

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

all as in *solifontis,* and even the pilosity of the two species is closely similar. The compound eyes of *dyak* are nearly twice the size of those of *solifontis,* and are more strongly convex and protruding laterally. Clypeus depressed and excised anteromedially.

Petiolar node as in *solifontis,* longer than broad and slightly longer than its peduncle; spongiform appendages well developed, but the lateral lobes not reaching the anterior nodal slope. Postpetiolar node smaller than that of *solifontis,* barely broader than long and only slightly broader than the petiole, its disc convex, smooth and shining, with a few short, weak longitudinal costulae along the anterior border. Unlike those of *solifontis,* the definitely smooth, shining areas on the sides of the alitrunk in *dyak* are restricted chiefly to the lower mesopleura. Basal gastric costulae somewhat spongiform, extending about 1/5 the length of the basal tergite.

Ground pilosity of head rather sparse, consisting of subreclinate to obliquely erect, short, fine truncate hairs, becoming feebly spatulate on the free clypeal margin. Scape hairs fine, directed apicad. Ground hairs of alitrunk rare, fine and inconspicuous, appressed to reclinate. About 6 longer, erect, fine truncate hairs bordering each occipital lobe laterally, posteriorly and medially; 3 pairs of the same on the alitrunk, the humeral pair being long and subflagellate, mesonotal pair long, pair on mid-pronotum not so long, inclined anteriorly. Sparse growth of long, fine erect hairs on petiole, postpetiole and gaster. Propodeal teeth acute and elevated, their infradental lamellae moderate in size, but expanded below and with a small growth of spongiform tissue laterally. Color ferruginous yellow (possibly faded); dorsum of head, except occipital lobes, faintly more pigmented. Mandibles and appendages light yellow, with red-brown teeth on the former.

Holotype a single worker from "head Camp, N. Borneo" (leg. E. Mjöberg, British North Borneo collecting tour), deposited in MCZ.

Paratype a single worker in MCZ, "foot of Mt. Murud," North Borneo (Mjöberg leg.). Size slightly smaller than in holotype, but proportions of head and mandibles identical.

TL 2.8, HL 0.73, WL 0.73 mm. Color a trifle darker than in holotype.

This species can be separated from *godeffroyi, indagatrix* and other similar forms occurring in Borneo by its larger size; sparse, fine, largely erect pilosity; and slender, constricted alitrunk.

Strumigenys mjoebergi sp. nov.

Holotype worker: TL 2.4, HL 0.65, ML 0.29, WL 0.60 mm.; CI 68, MI 45. Very similar to *S. godeffroyi,* but differing slightly in size and proportions, and more strongly in sculpture, pilosity and color. Mandibles very slightly more curved than in *godeffroyi,* the preapical tooth long and extremely close to the apical fork; insertions rather widely spaced apart and the shafts robust. Alitrunk form much as in *godeffroyi.* Propodeal teeth acute, only weakly elevated, their infradental lamellae weakly convex below, thin and nearly transparent, without spongiform masses on their lateral faces. Petiolar node a little longer than broad, much as in *godeffroyi,* but the posterior and lateral spongiform appendages scanty. Postpetiolar node distinctly broader than petiolar node, a bit less than half as wide as the gaster, strongly convex, the surface densely punctulate-striate, opaque; spongiform appendages well developed, but less strong than in *godeffroyi;* much of the sides of the node free, especially the anterolateral surfaces. Gastric costulae coarse, numerous, extending ⅓ or more the length of the basal gastric tergite; rest of gaster smooth. Alitrunk completely punctulate and opaque. Ground pilosity of head consisting of short decumbent hairs, narrowly spatulate or clavate, much heavier than in *godeffroyi.* Ground pilosity of alitrunk fine, sparse, very inconspicuous, reclinate. A few short, stubby, erect spatulate or clavate hairs on the occipital lobes, a pair on the center of the pronotum, another on the mesonotum, and a longer humeral pair; sparse complement of distinctly spatulate erect hairs on nodes and gastric dorsum. Color sordid ferruginous yellow, dorsum of head, except occipital lobes, faintly darkened; gaster darker, brownish; lower halves of sides of alitrunk deep reddish brown; mandibles, antennae and legs yellowish.

Holotype [MCZ] from Nata Ragong, North Borneo (E.

(Mjöberg leg.) without further data, but probably from rotten wood.

Paratype workers: 4 specimens with same data as for holotype [MCZ, USNM]. TL. 2.4-2.6, HL 0.68-0.71, ML. 0.29-0.30, WL. max. 0.68 mm.; CI 68-70, MI 43-44.

Paratype female: one dealate with same data as for holotype: TL 3.0, HL 0.74, ML 0.30, WL 0.78 mm.; CI 74, MI 41. Mesonotum evenly and densely punctulate throughout, without median sulcus or carina; bearing a few short, erect spatulate hairs. Scutellum convex, not strongly projecting. Anterior corner of mesanepisternum smooth and shining. Petiolar node broader than long. Sculpture of postpetiole and base of gaster stronger than in the worker, the latter extending half the length of the basigastric tergite in the middle. Other differences as usual for the caste; color like that of worker.

This species is distinguished from most *godeffroyi* group species by means of its striate, opaque postpetiolar disc. From the few forms with similar postpetiolar sculpture, *mjoebergi* differs in the position of the preapical tooth of the mandibles and in pilosity, other sculpture and color.

Strumigenys sublaminata sp. nov.

Holotype worker: TL 2.3, HL 0.61, ML 0.22, WL 0.61 mm.; CI 73, MI 36. A member of the *godeffroyi* group with rather short mandibles, similar to *S. jepsoni* Mann from the Fijis, but with more deeply excised posterior cephalic border and different sculpture and pilosity, etc.

Preocular laminae parallel, eyes convex, protruding laterally. Anterior clypeal border weakly concave in the middle. Mandibles stout, weakly arcuate and gently tapering toward apex. Teeth of apical fork subparallel, the ventral tooth a little more than half as long as the dorsal; two very indistinct intercalary denticles. Preapical tooth long and slender, about ⅔ the length of the dorsal apical tooth and set about half or a little more its own length distant from the dorsal apical tooth. Inner border proximad of preapical tooth very feebly concave and with a faint indication of subcultrate (laminate) margination.

Anterior half of alitrunk convex above, posterior half a little lower but forming a completely continuous, very nearly straight (feebly convex) profile, without indication of metanotal groove. Propodeal teeth small, acute, subtended by ventrally broadened and convex lamellae without lateral spongiform facing. Petiolar node gently rounded above, longer than broad and slightly longer than its peduncle, its spongiform appendages limited to a moderate posterior rim and an anteriorly lobate midventral strip. Postpetiolar disc convex, about half again as broad as long and approximately half as broad as the gaster, with well developed appendages. Gaster narrow; basal costulae very short, somewhat spongiform in consistency. Postpetiolar disc, gastric dorsum, fore coxae, propodeal declivity and lower halves of sides of alitrunk nearly or quite smooth, strongly shining. Remainder of body densely punctulate, opaque; pronotum laterally with weak substriation.

Ground pilosity of head consisting of fairly conspicuous short, subreclinate spatulate hairs, anteriorly directed, forming regular fringes on anterior dorsal scrobe borders, anteior clypeal border and anterior borders of scapes, here directed toward scape apices. Promesonotum and dorsal surfaces of mandibles with similar hairs, but less conspicuous, directed mesad. Erect and inclined pilosity of short, stiff hairs with distinctly spatulate apices: 6 fringing posterior occipital margin, one on each lateral occipital margin, one pair on humeri and one pair on mesonotum, sparse rows of 4 each on petiole, postpetiole and gastric dorsum. Ventral side of head, and gaster near apex, with a few short fine hairs. Pilosity of appendages rather sparse, fine, subreclinate. Color rather uniform light ferruginous.

Holotype [MCZ] taken at 4000 feet altitude on Mt. Penrissen, Sarawak (Borneo) by E. Mjöberg, with no further data, but presumably from rotten wood. Seven paratype workers taken with the holotype [MCZ, USNM] show very little variation. TL 2.3-2.4, HL 0.61-0.63, ML 0.22, WL 0.61-0.62 mm.; CI 70-73, MI 35-36. Certain specimens show a slight effacement of the pronotal punctulation, giving this region a subopaque appearance somewhat like that of *S. godeffroyi.*

The dealate female paratype, taken with the holotype, has a very high-bulking thorax; mesonotum densely and finely punctulate, without rugulation or median furrow, but with about 20 erect spatulate hairs. Petiolar node broader than long; otherwise, only the usual caste differences from the worker. TL 2.8, HL 0.65, ML 0.24, WL 0.72 mm.; CI 77, MI 37.

Strumigenys indagatrix Wheeler

Strumigenys indagatrix Wheeler, 1919, Bull. Mus. Comp. Zool. 63: 94, worker. Type loc.: Kuching, Sarawak, Borneo [MCZ]. Cotypes (syntypes) in M. C. Z.

Cotypes, 2 workers: TL 2.5, 2.5; HL 0.60, 0.60; ML 0.32, 0.32; WL 0.62, 0.63 mm.; CI 67, 67; MI 53, 53. This species is extremely close to *S. godeffroyi*, and may even be only an extreme variant of that species. So far as can be told from the cotypes, *indagatrix* differs only in its slightly longer mandibles, slightly less well developed eyes and dorsal alitruncal pilosity, and somewhat more complete alitruncal sculpture; punctulation on pronotal dorsum and sides of alitrunk covers these areas completely and uniformly, without noticeable effacement.

Wheeler's treatment of this species could scarcely be more misleading. He regarded *indagatrix* as similar to *S. mocsaryi*, but said that "the mandibles are decidedly shorter," actually the reverse of the true situation. He then compared the species to four of five *Strumigenys* species described by Forel from Java in a paper published in 1905, saying that *indagatrix* was "smaller than any of them," a statement that does not hold well in the case of two of the species (*signeae* and *ebbae*). It is curious that of the four 1905 Forel species, none is very close to *indagatrix*, while the fifth (*juliae*), which Wheeler does not mention at all, is exceedingly close to both *indagatrix* and *godeffroyi*, if indeed it is separable at all. Wheeler's comparisons are all the more puzzling when one realizes that his collection contained samples determined by himself as both *juliae* and *godeffroyi*. *S. indagatrix* remains known only from the types, and until more samples turn up, it must remain doubtfully distinct from *godeffroyi*.

Strumigenys forficata sp. nov.

Holotype worker: TL 2.79, HL 0.68, ML 0.23, WL 0.74

mm.; CI 73, MI 34. Maximum width across clypeus 0.27 mm.

Similar to *S. guttulata*, but the head narrower behind, with narrower occipital lobes. Mandibles stout and short, like those of *guttulata*, but the inner borders convex and bearing narrower convex, translucent lamellae that do not quite meet at full closure. Preapical tooth large, flattened, distinctly recurved, translucent in texture, much as in the lamella. Dorsal apical tooth straight, slender and quite acute, but only about 0.05-0.06 mm. long; ventral tooth stout, divergent, a little shorter than the dorsal tooth; 2 (possibly 3) intercalary denticles present. Antennal scrobes distinct, broad and deep, their dorsal borders distinctly produced laterally as slightly raised, anteriorly convex, thin but opaque lamellar borders. Center of head in region of vertex evenly convex; occipital lobes very feebly depressed. Posterior excision very broad, deep and semicircular, except that a broad, almost straight-edged translucent lamella fills its bottom, so that the excision appears broad and truncate in outline from dorsal view. Clypeus triangular, distinctly broader than long; posterior angle extended acutely, but narrowly rounded at the tip; anterior border very nearly straight, only very feebly depressed and concave medially. Eyes are small and situated at about the midlength of the head. Preocular laminae approximately straight and only feebly converging anteriorly.

Alitrunk rather narrow seen from above, only slightly wider across pronotum than through propodeum; anterior pronotal border narrowly rounded, with a projecting cultrate lamellar margin overhanging a deep transverse excavation in the dorsum of the cervix; anterodorsal margin of latter produced as a flange. Promesonotum in profile moderately convex; posterior mesonotum gently concave; metanotal groove obsolete; propodeal dorsum feebly convex. Propodeal teeth long, fine and spiniform, wholly enveloped in the thick, white opaque infradental lamellae, which are spongiform, broad but with irregular, feathery concave borders terminating in a higher ventral point. Since only the holotype is available, the feathery spongiform lamellar structure may possibly be an artifact, but there is nothing definite to indicate that other than the natural condition prevails.

Petiolar node quite high, shorter than its peduncle, with a narrowly rounded anterior summit and a gently convex sloping posterodorsal face; anterolateral surfaces excavated and the two carinae of the anterior nodal slope fused into one median carina which mitigates the steepness of the slope as seen from lateral view. These modifications render the lower part of the anterior nodal slope rather narrow or "pinched" as seen from the front. Seen from above, free portion of posterodorsal face oval, slightly longer than broad and narrowed in front. Posterior collar broad (damaged on left side) with large posterolateral lobes of feathery spongiform material; midventral spongiform strip well developed. Dorsolateral and lateral surfaces of node with some reclinate, feathery spatulate hairs partly obscuring surface. Postpetiolar disc transverse-ellipsoidal, convex, moderate in size, but nearly twice as broad as long and twice as broad as the petiolar node, with very well developed spongiform masses; periphery of the disc with a few inconspicuous, reclinate feathery-spatulate hairs.

Gaster with a dense pad of fine hairs anteroventrally and a dense, broad anterodorsal margin of spongiform material meeting that of the postpetiole. A band of numerous short filiform costulae extending from the anterior spongiform margin a short distance onto the surface of the first gastric tergite, otherwise smooth and shining. Posterior surfaces of occipital lobes, alitrunk (except for dorsal surfaces of mesonotum and propodeum), most of petiolar node, postpetiolar disc, mandibles and fore coxae very nearly or quite smooth, shining. Clypeus subopaque. Most of head, entire mesonotum and dorsum of propodeum, scapes, most of legs and peduncle of petiole densely and finely punctulate, opaque or subopaque.

Entire dorsal pilosity consisting, with the few exceptions noted below, of moderately conspicuous appressed to decumbent spatulate or narrow cochlear hairs, those on the head abundant and uniform, directed anteriorly, diminishing on the occipital lobes toward the naked apices of the lobes; those on scape nearly appressed and directed apicad; those on clypeus smaller and finer than on rest of cephalic dorsum, forming an inconspicuous fringe anteriorly; those on promesonotum few, somewhat feathery in consistency. Gaster with a few small, subreclinate, anteromedially inclined subspatulate hairs along the anterior margin. Sparse, small fine hairs, mostly appressed or decumbent, on underside of head, on mandibles, legs, propodeal dorsum, venter of gaster and apex of gaster.

Color medium ferruginous; mandibles, appendages, apices of occipital lobes, apex of gaster and both nodes lighter, yellowish. First gastric tergite medium reddish brown. Holotype a unique [MCZ] taken at Mt. Murud, North Borneo (E. Mjöberg leg.), no further data.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month October through May at 8:00 p.m. in Room B-455, Biological Laboratories, Divinity Ave., Cambridge. Entomologists visiting Boston are cordially invited to attend.

BACK VOLUMES OF PSYCHE

The Cambridge Entomological Club is able to offer for sale the following volumes of Psyche.

Volumes 3, 4, 5, 6, 7, 8, each covering a period of three years, $8.00 each.

Volumes 10, 14, 17 to 26, each covering a single year, $2.00 each.

Volumes 27 to 53, each covering a single year, $2.50.

Volumes 54 to 64, each covering a single year, $3.00.

Some other volumes, lacking certain issues, are also available (information upon request).

Orders for 2 or more volumes subject to a discount of 10%.

Orders for 10 or more volumes subject to a discount of 20%.

All orders should be addressed to

F. M. CARPENTER, Editor of Psyche,
Biological Laboratories,
Harvard University,
Cambridge, Mass.

FOR SALE

CLASSIFICATION OF INSECTS, by C. T. Brues, A. L. Melander and F. M. Carpenter. Published in March, 1954, as volume 108 of the Bulletin of the Museum of Comparative Zoology, with 917 pages and 1219 figures. It consists of keys to the living and extinct families of insects, and to the living families of other terrestrial arthropods; and includes 270 pages of bibliographic references and an index of 76 pages. Price $9.00 (cloth bound and postpaid). Send orders to Museum of Comparative Zoology, Harvard College, Cambridge 38, Mass.